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Procedia Social and Behavioral Sciences 2 (2010) 2750–2754

Procedia
Social and Behavioral Sciences

WCES-2010

Interactive methodology improves the learning process for engineering students

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Received October 22, 2009; revised December 31, 2009; accepted January 12, 2010

Abstract

There is a need to properly set the relative scores of the different activities on the final evaluation. The aim of this study was to analyze i) the monitoring and scores of the different activities of continuous assessment proposed in a mandatory course, ii) the type of questions that best evaluate and discriminate the learning process. The activities programmed for the course were 24% on-line and 76% on-site attendant, and within the on-site attendant 25% were performed in groups. No differences were observed both in the attendance or the scores obtained among the different kind of activities (about 63% and 7.7 out of 10, respectively). The scores obtained in the questions related to the activities performed were 2.2 points higher for the students that had done the activities respect to those that had not done them. Analyses of the difficulty and discrimination index were carried out for the items included in the on-line test.

Keywords: Learning process; engineering students.

1. Introduction

One of the main difficulties for teachers is to evaluate the knowledge and competencies of their students in groups of more than 20 students. The traditional system, with one (or more) writing exam at the end of the term is efficient for measuring the conceptual knowledge although it is little sensitive for evaluating competencies and attitudes (Kauffman et al. 1971). Since the academic year 05-06 and following the Bologne system guidelines, a continuous evaluation system has been implemented for an Applied Animal Production course at our Department. This kind of evaluation is able to measure competencies; however the mixture of innate and learned capacities hampers the knowledge assessment. Therefore, there is a need to properly set the relative scores of the different activities on the final evaluation (Biggs, 1999).

The aim of this study was to analyze i) the monitoring and scores of the different activities of continuous evaluation proposed in a mandatory course, ii) the type of questions that best evaluate and discriminate the learning process.

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doi:10.1016/j.sbspro.2010.03.408

2. Course description

Zootecnia II is the second course of a mandatory discipline of the Animal Production area and includes swine, poultry, cattle and sheep production, with 9 credits which implies 90 attendant hours (from February to June), at the Higher Technical School of Agricultural Engineering of the Universidad Politécnica de Madrid. The first course (Zootecnia I), includes animal physiology, reproduction and nutrition, which constitute the basis for the applied animal production.

The teaching process was organized as on-site attendant, with lecturers as the main way of teaching. However many complementary activities were programmed to consolidate and apply the knowledge. About 24% of the activities were programmed on-line and 76% on-site attendant, and within the on-site attendant 25% were done in groups. A learning platform (Moodle, see Figure 1) was used as a support to the lecturers as a blended learning strategy, that combined classroom teaching with electronic exercise work. Both the slides used in the lecturers and other complementary information, as papers, videos, webs were attached in the learning platform. After each lesson of a teaching unit, questionnaires are proposed as a mean of self-assessment test. To promote the use of the self-assessment tests, they account as 5% of the final score. At the end of the teaching unit a global on-line test was programed to be done in a computer classroom where all the students performed it simultaneously. The score awarded for each unit depended on performances assessed in the different learning activities programmed. In the same way, the final score of the course was obtained by combining the scores of different units.

Figure 1. Moodle platform of one of the units of Zootecnia II course

2.1. Study

A study was carried out in one of the four groups (with 35 students) of the course where the different activities were monitored and evaluated. In this way, the best activities to reach the learning objectives should be selected, and the inefficient ones should be modified. Afterwards, some questions were designed to evaluate the learning degree of the concepts developed in the activities in the global on-line test. On the other hand and taken into account that a part of the evaluation process was done on-line, an special care should be taken for the test design in order to obtain an accurate evaluation and discrimination (Sim & Rashia, 2006).

2.1.1. Methods

Difficulty and discrimination index of each question or item within the test was calculated from the general results of the moodle platform. Difficulty index was calculated as the proportion of students who answered the

the platform that reflect the average score respect to the maximum. Therefore, as higher difficulty index of a question, easier is to perform it. Discrimination index was calculated as: number of students that answered the question partially correct (>5) in the high scoring group (third higher group) minus number of students that answered the question partially correct in the low scoring group divided by the number of students in each group. Also a discrimination coefficient was calculated as the correlation coefficient among the question score and the overall test score. This coefficient takes into account all the students, not only the 2 subgroups.

3. Results and Discussion

One of the main problems of our University is the low percentage of students that attended the lecturers. In a study of the Universidad Complutense de Madrid, García & Covadonga, (2008), related the truancy with some organization problems as courses timetable overlap, registering system, or the distance between home and University; but also with aspects linked to teaching system, as learning resources availability at University. One way of decreasing this absenteeism is the continuous assessment. In this sense, 93.1% of the students evaluated in 08-09 Zootecnia II course (140 students) followed the continuous assessment, 83% of them carried out the on-line self-assessment test, but only 35% of them performed successfully more than 50% of the programmed activities both in the classroom and outside. As a consequence, 33% of these students had to perform the final writing exam to pass the course

3.1. Monitoring of the continuous assessment

The monitoring of the different activities programmed for one of the groups, and the mean score obtained is shown in Table 1. Most of the activities programmed were on-site attendant (16 *vs* 5), and performed individually (17 vs 4). The proportion of students performing the different activities was about 63%, without differences according to the kind of activity (on-line, on-site, individual or in groups), but only 3% of them did not perform any activities, what indicates that the students try to follow the continuous assessment to make easier yield. No differences were found in the mean scores obtained among kind of activity (7.8 as average), but the variability of the scores obtained in the different activities (20% coefficient of variation as average) was much lower than the variability of the combined score of learning activities (60% coefficient of variation) due to the effect of the scores of non-attendant students. On the other hand, the on-site student attendance decreased along the term from 72.9 to 54.5%, however the scores obtained on the programmed activities increased 1 point (out of 10), indicating that the best students followed the course all the term.

The kind of activities programmed were in synthesis: i) analysis of documents about statistical information, web pages, tale reading, educational videos, farm visits, usually performed individually outside classroom and in groups in the classroom ii) cases studies performed always in groups in the classroom because its higher complexity, iii) mathematic problems that quantify different animal production or reproduction systems which difficulty degree lie on the concepts managed nor in the mathematical process, iv) conferences about hot topics, v) webquest about farm analysis or diet formulation exercise, vi) laboratory practice.

Table 1.Monitoring and average scores of the different activities performed

	On-site attendant		On-line
	Individual	Groups	Individual
Number of activities programmed	12	4	5
% Students doing the different activities	62.0	59.7	66.2
Mean score obtained (0-10)	7.7	8.4	7.4

Related to the learning objectives of some of these activities, questions were designed in the global test. Table 2 shows the monitoring or these activities and the average scores in the questions related to the learning activities of the students that performed or not the activities. The scores were 2.2 points higher as average for the students that had performed the activities. In the same way, the correlation among the global activity score and the global test for each learning unit varies from 0.3 to 0.6.

Table 2.Monitoring of the different activities and mean scores obtained in questions related to the concepts managed in the activities programmed by students that did or not the activities

Activities	N	Average % of students performing the activities	Average scores (0-10) of students that Perform activity	Not perform activity
Problems	6	62.13	7.13	4.30
Analysis and sinthesis of varied information	5	58.06	5.64	4.02
Assistence to Conference	1	71.0	4.1	1.1

The search and attachment of adequate resources to complement the learning process of students takes long time to the teacher. However, according to Table 3, if it an assessment work related to the resource were not programmed, most of students would have not used the resource. In our case, a great effort has been done to elaborate technical videos that hardly had been used by the students. The same happened with webs or forums. A surprisingly behavior was observed in the forum use, in which only 13% of the students participate actively when it was proposed, but some more students participate at the end of the term and what is more interesting most of them read the contributions of their colleagues.

Table 3.Use of the learning resources attached in the Moodle platform

Resource	N[1]	Resources characteristics or utilization	% students using the resource Moodle Mean	Range
Technical videos	5	Elaborated by teachers	14.2	3 - 39
	10	Selected from internet	11.6	6 - 23
Webs	3	With exercise attached	52.8	42 - 58
	15	Without exercise	5.8	0 - 13
Forum	1	Participant-Observer	19.4-77.4	

[1]Number of resources analyzed

3.2. Analysis of questions or items.

Sixty nine questions belong to four global test were analyzed in this study. Their difficulty index varied from 0.1 to 1, and the discrimination index from 0 to 0.9. A distribution and relationship between both indexes is shown in Figure 1. About 16% of the questions were difficult (difficulty index <0.3) and 36% easy (>0.8). Most questions had a good or very good discrimination index (>0.3), because the experience of the self-assessment questions where more than 800 questions are included (Villamide et al. 2007).

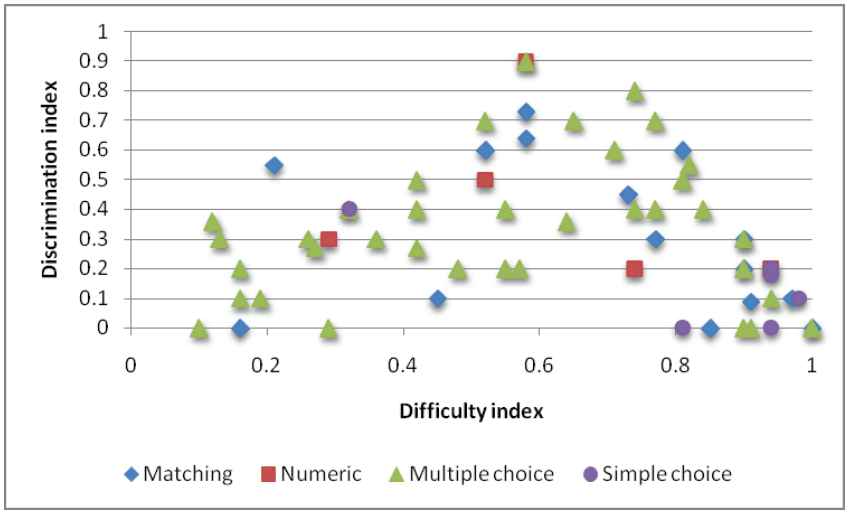

Figure 1. Distribution of the difficulty and discrimination index of the questions included in the global test

Questions of medium difficulty (0.4-0.8) discriminate better than very difficult or very easy questions. However, it is possible to formulate difficult questions with a good discrimination index (>0.3). Among the type of questions, numeric ones had the best good discrimination index, and simple choice questions the worse. Matching questions had a higher difficult index than multiple choice ones, because its format did not let us to correct by random effect.

The discrimination coefficient was as average higher (0.44) than the discrimination index (0.34), indicating good discrimination of the questions for all the population. These results agreed with those found in a previous work (Villamide et al. 2006) using another learning platform (AulaWeb) that only computed correct or wrong answers (not partially correct) and where the items could not be penalized. The question now is if with a combination of good items always it is obtained a good test. According to the results obtained in this group a higher number of questions (>20) and of different difficulty index should be used and with a proved discrimination index.

4. Conclusions

Interactive methodology improves the learning process for engineering students, but the student absenteeism which implies the non-attendant to some learning activities programmed makes difficult to carried out a continuous assessment in a mandatory course as Animal Production. Complementary resources for learning only were used by the students when they contributes to the final score. A high number of questions with medium difficulty index and as high discrimination index as possible should be included in the global test to get a more accurate evaluation.

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